moniliforme and a member of mycelia sterilia isolated, which were absent in pollen grains. These fungi possibly might have come with the wind when the scales were open for the pollination. The two fungi which were present in pollen grains but absent in the seeds, could not find the base for their establishment in the latter.

The presence of fungi in the seeds of compact cones which were not apparently mechanically injured, is a moot question. Gibson[2] reported that the seed coat of most of the conifers is resistant against invasion. These facts also favour the conclusion that the pollen grains are vectors for fungi at the time of pollination and fertilization.

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CYTOLOGICAL STUDIES IN *APONOGETON SATARENSIS* RAGHAVAN, KULKARNI AND YADAV

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GENUS *Aponogeton* L. is represented in India by five species. Asiatic species of *Aponogeton* are characterized by bisexual flowers and one spiked inflorescence only. However, a two-spiked, dioecious *Aponogeton* species, viz., *Aponogeton satarensis* Raghavan, Kulkarni and Yadav is of special interest from cytological standpoint[1]. Sharma and Chatterjee[2] reported $2n=76$ in *A. natans*. Moreover, other Indian species of *Aponogeton* still remain unexplored from this aspect of study. With this view in mind the present investigation was undertaken.

Plants collected from type locality and surroundings of Satara district (MS) are maintained in the gardens of Botany Department of this University. The karyotypic studies from root tips were performed after pretreatment with *p*-dichlorobenzene and then by applying normal aceto-orcein technique. For classification of karyotype asymmetry the scheme of Stebbins[3] was used and the nomenclature recommended by Levan *et al*[4] for centromeric position was adopted. For meiotic studies also, normal aceto-orcein technique was followed. Photomicrographs were taken from temporary preparations using mfAks system of JENAVAL Carl Zeiss microscope.

Somatic chromosome number of *A. satarensis* is $2n=26$ (figure 1). Chromosomes are in general short (2.30 μ–1.12 μ). On critical examination of the karyotype the following types of chromosomes were categorized.

Type A: One pair of long chromosomes (2.30 μ) with one constriction in the median (m) region.
Type B: Four pairs of comparatively long chromosomes (2 μ) with a constriction in the median (M) region.
Type C: Five pairs of medium size chromosomes (1.86 μ) with one constriction in the median (m) region.
Type D: Two pairs of short chromosomes (1.72 μ–1.58 μ) with one constriction in the median (M) region.
Type E: One pair of very short chromosomes (1.12 μ) with one constriction in median (M) region.

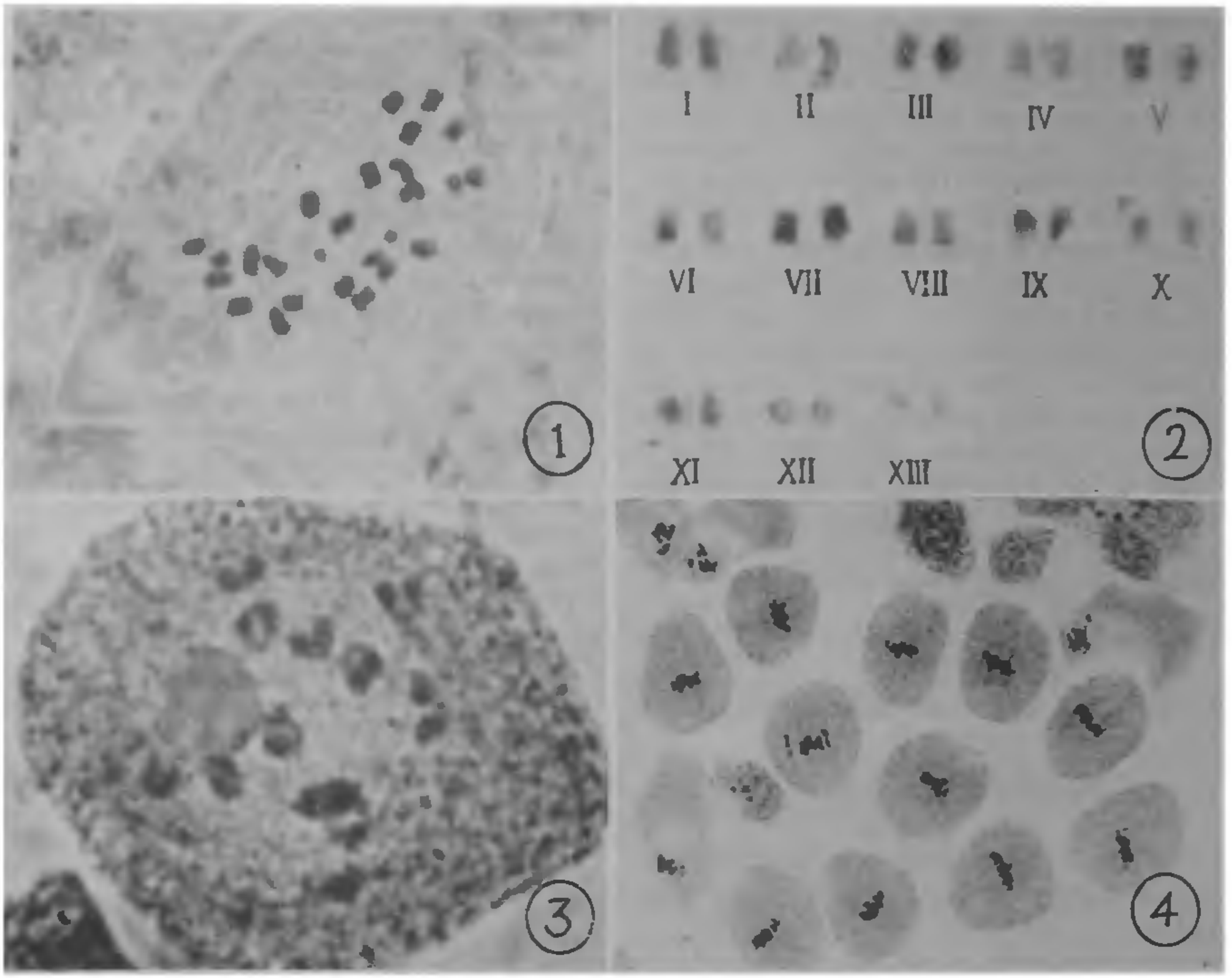
Thus karyotype formula of *A. satarensis* is represented as:

$$K:2n:26:2A^{m}+8B^{M}+10C^{m}+4D^{M}+2E^{M}.$$

The idiogram of species is represented in figure 2. Karyotype analysis has been done in both the male and the female plants of this species and no sharp differences have been observed in male and female plants.

During meiosis, the formation of 13 distinct bivalents at diakinesis was observed (figure 3). Smallest pair of chromosomes showed association with that of largest chromosomes in diakinesis, while metaphase-I was with normal orientation (figure 4). Generally the arrangement of microspores in tetrad was isobilateral, rarely decussate.

The present study is the first record of the diploid chromosome number, karyotype morphology and meiotic behaviour of *A. satarensis*. *Aponogeton distachyon* and *A. fenestralis* have shown[5,6] $n=8$, whereas in Indian species *A. natans* $2n=76$ was reported[2]. It is also interesting to note here that there is no significant difference in chromosome size (2.30 μ–1.12 μ) of *A. natans* and *A. satarensis*. It seems, therefore, that there is a definite indication of polyploidy and aneuploidy in evolution with a probable base number $n=13$. However, investigation



Figures 1–4. **1.** Mitotic metaphase showing 26 chromosomes (×700); **2.** Karyotype of *A. satarensis* (×1400); **3.** Diakinesis showing 13^{II}, association of shortest to longer chromosomes (×1375), and **4.** Metaphase-I (×60).

of other Indian species of *Aponogeton* is therefore necessary to decide the base number that have been responsible for speciation in the genus.

The closely graded size of the chromosomes suggest the symmetrical nature of karyotype in this taxon and this amply substantiated by a high TF% (47.79%). According to Stebbins[3] classification, it is classified in a 2A category, thus indicating primitiveness in general. It is considered that Najadales is representing the climax order derived from Aponogetonales through Juncaginales from Alismatales[2]. Thus primitiveness of this taxon is justified.

The male and female plants of this taxon showed identical karyotype having no difference in chromosome morphology. No heteromorphic pair could be obtained in meiosis, which suggest that in this dioecious plant there is no detectable sex chromosomes and the chromosomal control of sex is exerted by some genic factors. The association of smallest chromosomes with that of largest chromosomes in diakinesis is indication of origin of the shortest from the longest chromosomes in the course of speciation.

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